On a Freshwater Medusa from Rhodesia.

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With Plate 42 and 2 Text-figures.

THE material on which this note is based consists of a number of slides which I received from Mr. C. F. Rousselet, to whom my best thanks are due for his generosity in entrusting me with the description of these valuable specimens.

Mr. Rousselet had obtained the material from his friend, Mr. R. H. Thomas, who discovered the first specimen of the medusa in a tributary of the Hunyani River[1] in Southern Rhodesia in September, 1908. This specimen was sent to England, but, owing to its poor state of preservation and to the fact that an air-bubble was left in the tube in which it was sent, it arrived in a much damaged and macerated condition.

Mr. Rousselet wrote immediately to ask for better preserved material, and a few more specimens were obtained and sent in December of the same year; these were, unfortunately, also somewhat damaged in transit. Mr. Thomas endeavoured to collect more medusæ but found that they had completely disappeared; he has since left the district and the chance of receiving further specimens is somewhat remote.

The tubes containing the medusæ were accompanied by some pencil sketches of the living animal, and, whilst congratulating Mr. Thomas on his most interesting discovery, I should like to take this opportunity of expressing to him my appreciation of the great trouble which he has taken in his endeavours to send well-preserved material back to this country.

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[1] The River Hunyani (or Hanyani), is one of the largest of the southern tributaries of the Middle Zambesi.

Altogether four medusæ reached me in sufficiently good condition for investigation; of these two were almost complete, the other two fragmentary, each being represented by a sectant of the umbrella to which a portion of the manubrium was attached.

All the specimens were mounted in formalin in cells ringed with gold size.

A mere glance at these medusæ is sufficient to show that they belong to the very remarkable genus Limnocnida, of which the only known species, L. tanganicæ,[1] was discovered by Böhm (**1**) in Lake Tanganyika in 1883, and for a complete description of which we are indebted to R. T. Günther (**2**, **3**). The medusa was at first thought to be peculiar to this lake, and the halolimnic theory of the origin of Lake Tanganyika was based, at least in part, on its presence there.

Since that time Limnocnida tanganicæ has been found in the Victoria Nyanza (**6**, **10**)[2] and in the River Niger (**8**, **9**), and Mr. Thomas's discovery of a similar jelly-fish in a tributary of the Zambesi shows that this remarkable genus must be a pretty constant constituent of the freshwater fauna of tropical Africa, occurring as it does in the four principal river systems of that continent.

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[1] In this, as in a previous paper (**12**) on the Tanganyika jelly-fish, I have adopted Günther's amended version of the spelling of the specific name of this medusa. When describing Dr. Cunnington's collection in 1907 (**10**), he remarked—"This would seem an appropriate occasion for advocating a more reasonable uniformity in the spelling of this specific name; and although in my original paper I had followed Böhm's spelling, tanganyicæ, in accordance with the laws of priority, in the present communication the more usual and shorter form tanganicæ is adopted. I have noted tanganyicæ, tanganicanus, tanganicensis, tanganyikæ, tanganyicensis, tanganikæ, and in Sollas's 'Age of the Earth,' p. 209, tanganyicœa!" E. T. Browne (**9**) has also adopted the revised spelling, but I notice that A. G. Mayer, in his monograph on the medusæ (**11**), uses the form tanganjicæ.

[2] Günther was able to detect distinct features in the Victoria Nyanza specimens, which he regarded as sub-specific in importance; he proposed for these the name L. tanganicæ var. victoriæ.

Limnocnida may even have a wide distribution outside Africa, for Dr. Annandale, in a recent letter to 'Nature' (**13**), announces the discovery of a similar medusa in India. A number of jelly-fish were obtained by Mr. S. P. Agharkar from small streams in the Western Ghat, these streams belonging to a river system which flows across the Indian Peninsula and reaches the sea more than 500 miles away on the shores of the Bay of Bengal. Dr. Annandale writes: "In the structure of the manubrium and digestive system, the position of the gonads, the structure of the tentacles and the form of the umbrella these medusæ agree precisely with Limnocnida tanganyicæ. As regards generic identity there can, indeed, be no doubt, and there is nothing in the specimens before me to suggest even a specific difference. They are not, however, in a particularly good state of preservation, having suffered somewhat in the post, and the question of specific identity may be left unanswered until after an examination of fresh specimens which I anticipate no difficulty in obtaining at a suitable season."

The medusæ from Rhodesia present a few peculiarities by means of which they can be easily distinguished from L. tanganicæ, and it is my intention to describe them as belonging to a distinct species under the name of Limnocnida rhodesiæ sp. n.

The specimens which I have examined differed from one another both in size and in the degree of contraction of the bell. I, therefore, find it convenient to describe the four individuals separately.

The most complete of the four medusæ before me was obtained by Mr. Thomas in December, 1908; its general appearance is very similar to that of the Tanganyika species, the bell having the characteristic flattened shape which one associates with the genus.

The umbrella has a diameter of 6 mm. The manubrium, as in L. tanganicæ, consists merely of a thin circular band measuring 2·75 mm. across its base, and the mouth is a wide circular aperture, the diameter of which is only slightly less than that of the whole manubrium.

Four radial canals run from the base of this organ to the umbrella edge, the latter being provided with a broad, somewhat muscular velum a little over 1 mm. in breadth.

There are between eighty and ninety tentacles, which are arranged, according to size, in distinct series, the perradial, interradial and adradial ones being the largest. The umbrella edge of this specimen is much macerated, and it is impossible to make out the exact mode of origin of the tentacles or the arrangement of the marginal sense-organs.

The second medusa, obtained in September of the same year, is of small size, measuring approximately 2·5 mm. in diameter; although badly broken it is in a much more satisfactory state of preservation and presents several features of great interest.

The very different degree of contraction of both umbrella and manubrium renders the animal very unlike the individual just described. The umbrella margin is much contracted and this makes the medusa appear comparatively much higher, in fact almost hemispherical in shape. The manubrium also appears very different and has the shape of a truncated cone, the base of which measures about 1 mm. in diameter.

The conical form of the manubrium is due to the contraction of its oral extremity, and when this organ is viewed from below the mouth is seen to be almost completely closed, appearing as a small opening surrounded by the folded oral edge of the manubrium (Pl. 42, fig. 1).

In possessing an almost closed mouth this individual is of considerable interest, in all the described specimens of Limnocnida tanganicæ the mouth remained wide open, and previous writers have laid great stress on this character; thus Günther refers to "the wonderfully large mouth which the short manubrium seems inadequate to close," and

E. T. Browne, in his description of the Niger specimens (**9**), remarks that to judge from the appearance of the medusæ "the mouth is incapable, owing to the shortness of the lower wall of the stomach, of completely closing up."

I do not consider the point just dealt with to be one of systematic importance. The first medusa I described had a widely open mouth similar to that of L. tanganicæ, and I think it highly probable that a more exhaustive study of living examples of the latter species will reveal the fact that the manubrium is capable of great changes in shape. It must also be remembered that the specimen I have been describing is a young one, and the figures given by Günther of similar-sized individuals of L. tanganicæ suggest that at this stage the manubrium has greater powers of contractility than in the adult.[1]

Although much torn, the umbrella edge of this individual is not at all macerated, and the structure of the marginal region forms the main distinguishing feature of the Rhodesian species. In this form the "nettle-ring," instead of forming a broad continuous band round the margin of the umbrella as in L. tanganicæ, is considerably narrower and, moreover, discontinuous, the masses of stinging-cells being grouped round the bases of the tentacles and giving rise to distinct bulbous swellings similar to the tentacle bulbs which have been described in many Trachymedusæ, e.g. *Gonionemus murbachi* (Pl. 42, fig. 2).

The tentacle-bulbs are equally well developed in the third of the four medusæ entrusted to me by Mr. Rousselet. This individual is very incomplete, and is represented by a sectant of the bell and part of the manubrium; as in the medusa just described the umbrella-margin is well preserved, and both show very clearly another structural difference between L. rhodesiæ and L. tanganicæ.

In the Tanganyika species there is no obvious relation between the arrangement of the marginal sense-organs and that of the tentacles, whereas in the Rhodesian medusæ such a relation between the arrangements of the two sets of organs certainly exists.

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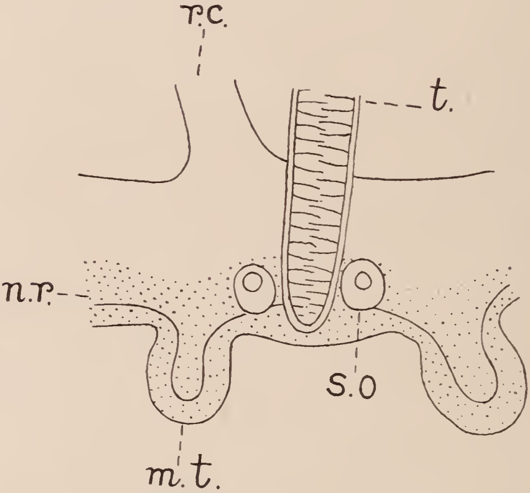
[1] Cf. Günther (**10**), p. 646, text-fig. 172.

Each of the smaller tentacle-bulbs bears a single sense-organ, basally situated near the origin of the velum ; on the larger bulbs a second sense-organ is usually developed, although occasionally it is missing, just as in a few cases a sense-organ may fail to develop on one of the smaller tentacle-bulbs (Pl. 42, fig. 2).

Text-fig. 1.



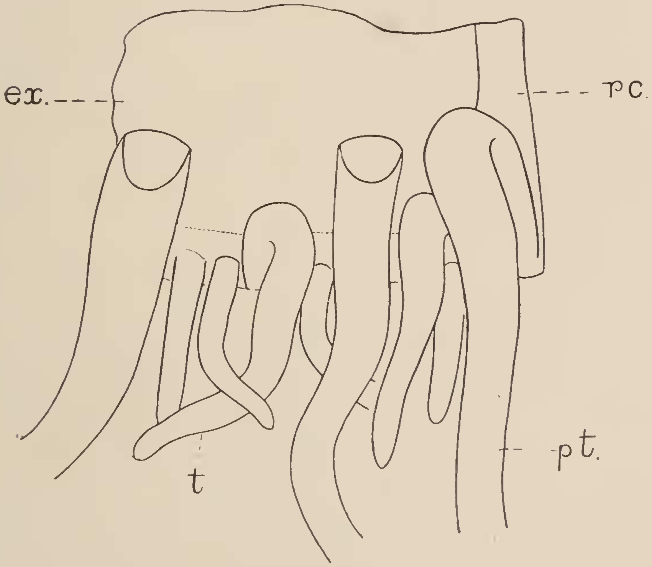
Part of the umbrella margin of Olindias phosphorica (mülleri), to show a pair of sense-organs developed at the base of one of the primary tentacles. *n.r.* Nettle-ring. *t.* Tentacle. *s.o.* Sense-organ. *r.c.* Radial canal. *m.t.* Club-shaped marginal tentacle. (× 45.)

This arrangement of the marginal sense-vesicles recalls that which occurs in many species of Olindias, where a pair of these structures is to be found at the base of each of the primary tentacles (Text-fig. 1).

The structure of the sense-organs seems identical in every respect with that of the similar organs met with in L. tanganicæ, although they appear to be somewhat larger than in that species. In this individual there are about thirty tentacles and thirty-eight sense-organs to the quadrant; the umbrella of the complete medusa must have measured at least 12 mm. in diameter.

A portion of the manubrium is also present, and this shows the animal to be sexually mature, an ovary being developed as a broad ring round the base of the organ (Pl. 42, fig. 5). The ova seem ripe, and under high magnification appear polygonal in shape; they are provided with large clear nuclei, each with a distinct nucleolus (Pl. 42, fig. 6).

TEXT-FIG. 2.



Part of the umbrella margin of Limnocnida rhodesiæ as seen from the exumbrellar surface. This figure shows the attachment of the tentacle-bases to the exumbrellar surface of the bell. *r.c.* Radial canal. *t.* Tentacle. *p.t.* Per-radial tentacle. *ex.* Exumbrellar surface of the bell. (× 45.)

The last of the four slides before me bears a fragment of a medusa, which must have had very nearly the same dimensions as the specimen just described. The umbrella margin is too macerated to allow me to make out anything of the structure of the nettle-ring, or of the arrangement of the sense-organs.

A small piece of the manubrium is attached to the umbrella, and shows that this individual is also a female; the ovary, however, seems but poorly developed.[1]

In all four medusæ the tentacles are in a good state of preservation, and in their structure very closely resemble those of Limnocnida tanganicæ. As in that species the larger tentacles are attached to the exumbrella surface of the bell for a considerable distance (Text-fig. 2); they are, however, not deeply imbedded in the jelly as in the Victoria Nyanza specimens described by Günther (**10**), nor could I find distinct projecting supports, such as Browne figures in the medusæ collected by Budgett in the R. Niger (**9**).

The nematocysts are of the same size and shape as those of L. tanganicæ, and are grouped in distinct batteries, which on the extended tentacles are irregularly distributed and situated at the extremities of conspicuous papillæ (Pl. 42, fig. 3), recalling those which occur on the tentacles of another well-known freshwater medusa, Limnocodium sowerbii.[2] As in the Tanganyika species, the nematocyst batteries are absent from the proximal parts of the tentacles, in which position however, numerous isolated stinging-cells are to be seen making their way to the more distal parts. In the largest tentacles quite a third of the organ is free from nematocyst batteries, and even the smallest have these structures absent from at least a small basal portion.

The above account of the medusæ collected by Mr. Thomas makes it evident that the two species of Limnocnida are closely allied to one another, and agree in many essential features. L. rhodesiæ can, however, be readily distinguished from L. tanganicæ by the structure of its umbrella-margin with distinct tentacle-bulbs and regularly arranged sense-organs.

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[1] The two gonad-bearing medusæ were obtained by Mr. Thomas in December, 1908.

[2] Cf. E. T. Browne, "On the Freshwater Medusa liberated by Microhydra ryderi, Potts, and a Comparison with Limnocodium," 'Quart. Journ. Micr. Sci.,' vol. 50, 1906, pl. 37, fig. 3.

When I first examined the Rhodesian medusæ these characters appeared very striking, and seemed of considerable importance; the differences, however, seemed much less conspicuous when the umbrella-margins of the two species were examined side by side. I, therefore, made a careful study of the marginal region of L. tanganicæ, and have figured a small portion of the nettle-ring and neighbouring organs of this species for comparison with the similar figure of L. rhodesiæ (vide Pl. 42, figs. 4 and 2).

The nettle-ring of L. tanganicæ has been described as forming a broad, continuous band along the margin of the umbrella; this is certainly quite correct, but it is to be noted that this band, although continuous, is not of equal thickness throughout. The axes of the larger tentacles can be seen through the nettle-ring (Pl. 42, fig. 4), and on the sides of these the latter structure is considerably thickened, so that, although distinct tentacle-bulbs are not formed, they are at least indicated, a point which seems to have escaped the notice of previous students of this medusa. Moreover, these have stated their inability to make out any relation between the arrangements of the sense-organs and tentacles in L. tanganicæ. A careful examination of the umbrella margin of this species has convinced me that such an arrangement does exist although it is somewhat obscure.

In an adult medusa the marginal sense-organs are so numerous as to form an almost closed ring round the circumference of the umbrella; occasional gaps are, however, left. Now each of these gaps is invariably situated opposite the base of one of the larger tentacles, and when the sense-organs on either side of it are examined it becomes obvious that they form a pair belonging to the tentacle in question (Pl. 42, fig. 4 *a*, *a* and *b*, *b*).

The crowded sense-organs between such pairs roughly correspond with the smaller tentacles; the latter are, however, somewhat more numerous because sense-organs are not developed at the bases of the youngest ones (the so-called marginal tentacles).

We see then that L. tanganicæ shows traces, not only of the tentacle-bulbs of the Rhodesian species, but also of a similar arrangement of the marginal sense-organs; I think it highly probable that it has been derived from some medusa bearing distinct basal bulbs which carry the sense-organs.

It seems the custom for writers on Limnocnida to make some remarks on the systematic position of this peculiar type of jelly-fish. Unfortunately the structure of the new species does not shed much light on the difficult problem of the affinities of this genus; the similarity in the arrangements of the marginal sense-organs of L. rhodesiæ and certain species of Olindias is perhaps significant, since there seems a tendency amongst recent writers on the subject to ignore the manubrial position of the gonads of Limnocnida and to place the genus together with Limnocodium close to the Olindiadæ among the Trachymedusæ.

BIRMINGHAM,
December 11th, 1911.

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EXPLANATION OF PLATE 42,

Illustrating Mr. C. L. Boulenger's memoir "On a Freshwater Medusa from Rhodesia."

List of Reference Letters.

ex. Exumbrellar surface of the umbrella. *m.* Mouth. *man.* Manubrium. *n.* Nucleus of an ovum. *nem.* Nematocyst. *nem. b.* Nematocyst battery on a tentacle. *n.r.* Nettle-ring. *o.* Ovum. *ov.* Ovary at the base of the manubrium. *pap.* Papilla of ectoderm bearing the nematocyst battery. *r.c.* Radial canal. *s.o.* Marginal sense-organ. *tent.* Tentacle. *tent. b.* Bulbous swelling at the base of a tentacle. *vel.* Velum.

Fig. 1.—The manubrium of a young individual of Limnocnida rhodesiæ, to show the contracted oral extremity and the four radial canals given off proximally. (× 45.)

Fig. 2.—A small portion of the umbrella-margin of L. rhodesiæ, showing the distinct tentacle-bulbs, which bear the sense-organs at their bases near the origin of the velum. (× 45.)

Fig. 3.—A part of the distal extremity of an extended tentacle of L. rhodesiæ. This shows the nematocyst batteries situated at the ends of distinct, elevated papillæ of the ectoderm. (× 260.)

Fig. 4.—A portion of the umbrella-edge of Limnocnida tanganicæ for comparison with fig. 2. The sense-organs marked *a*, *a* and *b*, *b* are pairs developed at the bases of the two tentacles bearing the same lettering. (× 45.)

Fig. 5.—A piece of the manubrium of a mature specimen of Limnocnida rhodesiæ. The ovary is developed as a ring round the base of the organ. (× 45.)

Fig. 6.—Ova of L. rhodesiæ as seen under a higher magnification. (× 260.)